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ABSTRACT

A study was conducted at a large, multi-campus, urban community college district to determine: (1) which science courses were being completed by women and minority students; (2) the completion rates of women and minority students in different areas of science, i.e., social science, mathematics, physical science, biological science, engineering, and agriculture; (3) the extent to which student performance in initial science courses is a good indicator of enrollment and performance in subsequent science courses; (4) the science-related careers of interest to women and minority students; and (5) the degree to which students interested in preparing for a science-related career are taking the courses needed to achieve their objectives. Answers to these questions were obtained from two data sources: the transcripts of 8,873 randomly selected students and the responses of 6,432 students to an in-class survey. The transcript analysis revealed that only 40% of the students had taken a science course, and that of these, 48% received an unsatisfactory grade. Students who earned a grade of "A," "B," or "C" in their initial science course were more likely to enroll in and complete a subsequent course. A high percentage of the students surveyed noted an interest in science-related careers, however many of these students had completed no science courses after completing 31 to 60 units of college credit. (JP)

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Center for the Study of Community Colleges

Paper presented at the 1981 Annual Meeting of the American Educational Research Association

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Student Participation and Success in Community College Science Education Programs

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A major objective of the National Science Foundation's sponsored study of Science Education for Women, Minorities, and Handicapped Students in the Los Angeles Community College District was to obtain answers to the following questions:

1. Which science courses do women and minority students complete?
2. How successful are women and minority students in completing courses in different areas of science?
3. Is student performance in the initial science course a good indicator of enrollment and performance in subsequent science courses?
4. Which science-related careers are women and minority students interested in pursuing?
5. Are students who are attending college to prepare for a science-related career taking courses needed to achieve their objectives?

Method

Answers to these questions were obtained from two data sources--(1) student transcripts and (2) a student survey.

Transcript Analysis

Answers to the questions on student course-taking patterns (Questions 1-3) were based on an analysis of 8,873 transcripts (a seven percent random sampling) of students enrolled in a large multi-campus urban community college district in Spring, 1979. The data analyses were based on all courses in which these

students were enrolled and were on record during the first census week (fourth week of the term) between Fall 1974 and Spring 1979. The transcripts were obtained on magnetic tape from the district's data processing center. Data analyses were conducted by staff members of the Center for the Study of Community Colleges under a grant from the National Science Foundation.

The science curriculum, as defined in this study, consisted of courses in agriculture, anthropology, biology, chemistry, earth and space science, economics, engineering, integrated natural science, mathematics, physics, psychology, and sociology. These courses all fell within the definition of the sciences as articulated by the sponsoring agency, the National Science Foundation.

Student Survey

Answers to the questions on student interest in science careers and the correspondence between student career objectives and courses taken (Questions 4 and 5) were based on 6,432 student respondents to a survey given in the fall of 1980. The survey was administered in all class sections offered at 10 a.m. and 7 p.m. on Wednesday of the fifth week of classes. Completed surveys were obtained from students in 268 of the 320 class sections in which the survey was administered. The classes used in this study represented a cross-section of the subject areas taught in the District.

Results

Percentage of Students Completing Courses in Science Areas

The data presented in Table 1 show the percentage of students who completed one or more courses in the six areas of science considered.

Just over 40 percent (42.6%) of the students in the sample completed at least one science course. The percentage of students who completed a course in

Table 1

Percentage of Students Who Completed

One or More Courses in a Science Area

(N=8,873)

Student Group	Total Science	Social Science	Mathe-matics	Physical Science	Biological Science	Engineering	Agriculture
Total Sample	42.6	24.9	19.8	16.3	10.7	4.0	.8
Male	44.2	21.7	22.9	19.0	8.9	7.8	.7
Female	41.1	27.6	17.2	14.0	12.2	.7	.8
American Indian	38.7	26.1	13.5	14.4	9.9	.9	0.0
Black	38.9	24.5	19.9	9.3	8.9	2.1	.1
Hispanic	37.6	20.1	17.8	12.9	8.7	4.2	.3
Asian	45.2	17.4	28.6	17.8	9.0	9.0	0.0
White	42.3	24.3	17.1	18.5	11.0	3.8	1.7

an area of science was in descending order: social science (24.9%); mathematics (19.8%); physical sciences (16.3%); biological sciences (10.7%); engineering (4.0%); and agriculture (.8%).

A greater percentage of males than females completed a course in mathematics (22.9% vs. 17.2%), the physical sciences (19% vs. 14%), and engineering technology (7.8% vs. .7%). Females were more likely than males to complete a course in the social sciences (27.6% vs. 21.7%) and the biological sciences (12.2% vs. 8.9%).

Asian students were much more likely than students in the other ethnic groups to complete courses in mathematics and engineering technology. In general, while there were differences in the percentage of students in the ethnic/race groups who completed courses in the different areas of science, the differences were not great.

Percent of Science Courses Completed

As demonstrated in Table 2, students in the Los Angeles Community College District completed 52 percent of the science courses in which they enrolled. The area of science in which students completed the highest percentage of their courses was agriculture (72%). This was followed by social sciences (56%), biological sciences (54%), engineering (54%), physical sciences (49%), and mathematics (48%). The course completion rates for males and females were similar in all science areas except engineering where the completion rate of males was substantially higher than that of females (55% vs. 42%).

Among the ethnic groups, Caucasian (56%) and Asian (53%) students completed a greater proportion of the science courses in which they enrolled than did Hispanics (48%), Blacks (45%), and American Indians (44%). Black students had a much more difficult time than Caucasians, Asians, and Hispanics in completing courses in mathematics, engineering technology, the physical sciences, and the biological sciences.

Table 2

Percentage of Science Courses Completed

Student Group	Total Science	Social Science	Mathe-matics	Physical Science	Biological Science	Engineering	Agriculture
Total Sample	52	56	48	49	54	54	72
Male	51	54	47	49	53	55	67
Female	53	57	48	49	55	42	76
American Indian	44	51	46	33	44	0	0
Black	45	49	41	41	46	38	0
Hispanic	48	50	46	43	52	49	0
Asian	53	53	53	48	55	61	0
White	56	59	49	55	57	63	72

Importance of the First Science Course

One of the objectives of this study was to examine the relationship between student grades in the initial science course and the enrollment in and completion of subsequent science courses. The data presented in Table 3 show that students who earned a high grade (A or B) in their first science course were much more likely to complete their subsequent science courses than students who received a low grade in their initial science course.

The science courses completed by students in each of the initial science course grade categories were as follows: A (67%), B (67%), C (63%), D (58%), F (54%), incomplete (34%), and withdrawal (27%). It is important to note that students who withdrew (W) or who received an incomplete in their initial science class completed a much smaller percentage of their subsequent science courses than students whose initial grade in science was C, D, or F. The fact that students who received a grade of I or W in their first science course enrolled in an average of three additional science courses suggests that many of these individuals needed to complete several science courses to achieve their educational objectives but may not have been able to do so.

Student Interest in Science Careers

Information on student interest in the sciences was obtained from an item on the Student Survey which asked respondents to indicate whether they were attending college to prepare for or advance in each of 14 career areas. Responses to this item are presented in Table 4.

The data presented in Table 4 reveals that a high percentage of students in the sample said they were attending college to prepare for or advance in a science-related career. The greatest percentage of the students who expressed an interest in a science career were attending college to prepare for or advance in engineering/architecture (16%). This was followed by computer programmers/ mathematician (15%), the health professions (14%), social scientist (9%),

Table 3

Average Number of Science Courses Enrolled

and Completed by Grade in First Science Course

(N=4,760)

Grade in First Science Course	Ave. Number of Science Courses Enrolled	Ave. Number of Science Courses Completed	Percentage of Science Courses Completed
A	5.4	3.7	67
B	5.1	3.4	67
C	4.7	3.0	63
D	4.9	2.9	58
F	4.1	2.2	54
I	4.3	1.4	34
W	4.2	1.1	27

Table 4

Percentage of Students Pursuing

Career Objectives by Ethnicity and Sex[a]

(N=6,426)

Career Objectives	Asian/ Filipino	Black	Chicano	Other Hispanic	White	Male	Female	Total
Health Professional	13	17	13	12	14	7	23	14
Doctor	6	6	6	6	5	6	6	6
Business	27	31	25	25	29	29	28	28
Secretary	4	7	4	6	5	.4	10	5
Comp. prog./mathematician/ statistician	23	16	12	14	13	18	11	15
Engineer/architech	27	11	13	19	15	26	5	16
Elem. or second. school educator	7	12	13	9	7	5	13	9
College teacher or educator	5	8	8	5	6	6	7	6
Farmer/forester	2	2	2	2	4	4	2	3
Research scientist	5	3	3	4	5	5	2	4
Artist	9	11	10	9	16	12	14	13
Social Scientist	6	10	10	8	10	6	12	9
Lawyer	4	9	6	7	6	8	5	6
Skilled trades	15	14	15	13	12	20	6	13

[a]Students were asked to check as many of the career areas as were applicable; therefore, the percentage add up to over 100 percent.

doctor (6%), research scientist (4%) and farmer/forester (3%).

As expected, a greater percentage of males than females were interested in careers in engineering/architecture (26% vs. 5%), and computer science/mathematics (18% vs. 11%); while a greater percentage of females than males were pursuing careers in the health professions (23% vs. 7%) and the social sciences (12% vs. 6%). There was a high degree of similarity in the percentages of males and females interested in the other areas of science.

The findings reported in Table 4 show that the Asian-American students were much more likely than students in the other ethnic/race groups to be interested in careers in computer science/mathematics and engineering/architecture. Otherwise, there was much similarity in the science career aspirations of students in the various ethnic/race groups.

Science Courses Taken By Students With Science-Related Career Objectives

One of the objectives of this study was to obtain information on the following question? To what extent are students attending college to prepare for or advance in a science-related career taking college science courses needed to achieve those stated objectives? Data on the college courses students had taken were obtained from an item on the Student Survey which asked respondents to indicate the number of college courses they had taken in each of 13 areas of science. Only students who had completed between 30 and 60 hours of college credit were included in this analysis. It was felt that students who completed less than 30 units of college credit may not have had an opportunity to take many science courses related to their career objectives while most of those who did complete over 60 semester units of college credit had taken science courses as part of their degree requirements in four-year colleges and universities.

The percentages of students in each of the career objective categories who had not taken any course in an area of science are given in Table 5.

Table 5

Percentage of Students in

Career Objective Categories Who Had

Taken No Courses in Science Areas

(N=1,302 Students Who Completed 31 to 60 Units of College Credit)

Career Objectives	Biology	Engineering	Mathe-matics	Physical Sciences	Social Science
Health Professional	48	99	33	38	18
Doctor	57	96	29	42	29
Business	80	94	25	44	20
Secretary	81	97	46	60	37
Comp. prog./mathematician/ statistician	83	84	12	38	30
Engineer/architect	81	55	13	37	48
Elem. or second. school educator	61	95	40	52	29
College teacher or educator	66	94	41	44	19
Farmer/forester	63	94	31	38	50
Research scientist	65	87	19	19	41
Artist	77	93	46	45	24
Social Scientist	63	97	36	48	12
Lawyer	72	97	30	37	19
Skilled trades	82	79	24	46	45

Here we find some discrepancy between the career objectives of students and the types of courses they completed. To illustrate, of those students who were attending college to prepare for or advance in a career in the health professions, 48 percent had not taken a course in biology,and over 30 percent had not completed a course in the physical sciences (38%) or in mathematics/ computer sciences (33%). Of those students who aspired to become medical doctors, 57 percent had not taken a biology course, 42 percent had yet to complete a course in the physical sciences, and 29 percent had not completed a course in mathematics/computer sciences.

Among students who desired a career in engineering technology/architecture, 55 percent had not included a course in engineering as part of their 30 plus hours of college and just under 40 percent (37%) had not taken a physical science course. However, most had taken a course in mathematics/computer sciences (87%). For those who expressed interest in the social sciences, all but 12 percent had taken a social science course. However, over 35 percent of the students had not completed a course in mathematics/computer sciences (36%), the physical sciences (48%), or biology (63%).

Nearly all of the careers listed in Table 4 require at least an Associate Degree. The attainment of a college degree is contingent upon students completing courses in mathematics, the biological and physical sicences, and the social sciences. The finding that such a high percentage of students who had completed between ten and 30 college courses had not taken a course in one or more of these areas suggests that mathematics and science may be operating as barriers to the realization of their educational and career objectives.

Discussion

The findings reported in this study can be summarized as follows: close to sixty percent of the students in a large urban community college district

completed no science courses while enrolled in that district; of those who did, 45 percent of the students received an unsatisfactory grade (D or F) or failed to complete the first science course in which they enrolled; students who earned a grade of A, B, or C in their first science course were much more likely to enroll in and complete additional science courses than those with grades of D, F, or W; students who withdrew from their first science course were likely to withdraw from most of their other science courses; and the grade students received in their initial science course saw a good indicator of the grades they earned in subsequent science courses. Results obtained in this study as well as in others clearly demonstrate that a high percentage of community college students—in all ethnic/race background and sex categories--do poorly in introducotry science courses and that grades in the first science course are strongly associated with enrollment, completion, and success in future science courses.

The findings presented in this study also revealed that a high percentage of the students in each of the ethnic/race and sex categories noted that they were attending college to prepare for or advance in a science-related career. However, of those who completed between 30 and 60 semester units of college credit, a high percentage had not yet taken courses in the areas of science and mathematics needed to prepare adequately for the fields in which they aspired.

Attainment of such educational objectives as an associate degree, occupational certificate and preparation for a career in science, technology, and engineering are often contingent upon students successfully completing two or more courses in science (including mathematics). Of the extraordinarily high percentage of students who do not successfully complete their first science course there are likely to be many who reassess their educational goals in an effort to avoid taking additional courses in science. To the extent that this occurs, the introductory science courses may actually serve to inhibit rather than promote attainment of two basic goals of community college science education programs--

increasing students' understanding of scientific and technical developments and their application in society; and heightening students' awareness and interest in career opportunities in science-related fields.

The finding that so many students did poorly in their first science course suggests that a high percentage of these individuals may not have had the skills needed to complete these courses successfully. To the extent that this statement is true--and the findings from other parts of the study suggest that it is--then colleges may be able to increase the students' chances of succeeding in science by placing them into science courses that are in line with their educational interests and abilities. Three approaches that have been instituted at some community colleges to promote student success in science courses are noted below: (1) place students in appropriate courses on the basis of such factors as courses taken in high school and college, tests of student knowledge in the area under consideration, and, where appropriate, ability level in mathematics, reading, and English; (2) offer beginning courses that serve as prerequisites to the general introductory courses; and (3) design distinctive courses that are appropriate for students in transfer, occupational, developmental, and personal enrichment programs.